

**REMARKS**

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have cancelled apparatus claims 19-22 without prejudice or disclaimer. Moreover, Applicants have amended the independent method claims in the application, claims 1, 7 and 10, to recite that the welding tool is pressed into only the one of the members, and that at least two of the plurality of members are of different metals from each other. Note, for example, pages 2 and 3, as well as page 9, of Applicants' specification. The remaining previously considered claims, directed to the friction stir welding method, have been amended in light of amendments to claims 1, 7 and 10.

In addition, Applicants are adding new claims 23-30 to the application. Claim 23, dependent on claim 1, recites that the shoulder has a diameter which is 8-20 times a thickness of the one of the members into which the welding tool is pressed; and claim 24, dependent on claim 7, recites that the tip end of the welding tool makes a contact angle in a range of 5°-20° with the member into which the welding tool is pressed. Claims 25-27, dependent respectively on claims 1, 7 and 10, recite that the plurality of lapped members are face-to-face; and claims 28-30, dependent respectively on claims 1, 7 and 10, recite that the welding tool is pressed into the one of the members in a thickness direction thereof, and does not extend through an entirety of the thickness of this one of the members.

In connection with the newly added claims, note, for example, pages 10 and 15 of Applicants' specification, as well as Figs. 2 and 3 of Applicants' original disclosure.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the

references applied by the Examiner in rejecting claims in the Office Action mailed June 15, 2006, that is, the teachings of the U.S. patent publications to Ezumi, et al., Patent Application Publication No. 2002/0092885, to Boon, et al., Patent No. 6,325,273, to Aota, et al., Patent No. 6,936,332, to Okamura, et al., Patent Application Publication No. 2003/0102354, and to Okamoto, et al., Patent No. 6,843,405, and the foreign patent documents of Thomas, et al., UK Patent Application No. 2,306,366, to Kano, et al., Japanese Patent Document No. 2002-314982, and to Michisaka, Japanese Patent Document No. 10-230376, under the provisions of 35 USC 102 and 35 USC 103.

Initially, it is noted that Ezumi, et al., has only been applied against apparatus claims 20-22, which have been cancelled from the above-identified application without prejudice or disclaimer. In view thereof, it is respectfully submitted that the rejection utilizing the teachings of Ezumi, et al., is moot.

As for the other claim rejections, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a friction stir welding method for a lap joint as in the present claims, in which a plurality of members are lapped, and wherein at least two of the plurality of members are of different metals from each other, and the welding tool is pressed into only the one of the members, as in claims 1, 7 and 10, and, moreover, wherein the welding tool has a small diameter projected part at a tip end of a shoulder, with the projected part and shoulder being pressed into only such one of the members (see claim 1), or wherein the tip end of the welding tool is semispherical in shape (see claim 7), or wherein a tip end of the welding tool is flat and an outer peripheral surface thereof is rounded (see claim 10).

Furthermore, it is respectfully submitted that the teachings of these applied references would have neither disclosed nor would have suggested such method as in the present claims, having features as discussed above in connection with claims 1, 7 and 10, and, moreover, wherein the plurality of lapped members are face-to-face (see claims 25-27); and/or wherein the welding tool is pressed into the one of the members in a thickness direction thereof, and does not extend through an entirety of the thickness of such one of the members (see claims 28-30).

Additionally, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such friction stir welding method as in the present claims, having features as discussed previously in connection with claims 1, 7 and 10, and, moreover, having additional features as set forth in the remaining, dependent claims, including (but not limited to) wherein the small diameter projected part of the welding tool is semispherical in shape (see claim 2), particularly wherein a recess is provided on the shoulder around the projected part (see claim 3); and/or wherein an outer peripheral surface of a tip end of the shoulder of the welding tool is inclined to define an inclined surface (see claim 4), or an outer peripheral surface of the this tip end of the shoulder is rounded (see claim 5); and/or a welding boundary surface is activated and welded by plastic flow, in which the pressing causes material of the one of the members to be discharged to an outer periphery of the welding tool (see claim 6; note also claim 9 and 12); and/or wherein the lapped surfaces of the plurality of members are coated with soft metal (see claim 15), in particular, are coated with any one of nickel, zinc and copper (see claim 16); and/or wherein a trapezoidal member is provided on a surface of the one of the members, on the side thereof into which the welding tool is pressed, to prevent an indentation produced due to pressing of the welding tool (see claim 17); and/or

wherein one of the members is provided on a lapped surface thereof with a groove, with another of the members being provided on a lapped surface thereof with a projected part, the projected part fitted into and welded to the groove (see claim 18); and/or relative diameter of the shoulder with respect to a thickness of the one of the members into which the welding tool is pressed (see claim 23); and/or wherein only a part of the semispherical shaped portion of the welding tool is pressed into only the one of the members to make a contact angle between welding tool and a surface of the one of the members an acute angle (see claim 8), in particular, wherein this contact angle is in a range of 5°-20° (see claim 24); and/or wherein the whole of the flat portion of and only a part of the rounded portion of the welding tool are pressed into only the one of the members (see claim 11).

The invention as presently claimed in the above-identified application is directed to a friction stir welding method, for providing a lap joint weld.

In welding a lap joint by means of friction stir welding, it is important to remove a surface oxide film on a lapped surface to activate a boundary interface. Therefore, it is necessary to heighten pressure of plastic flow. Applicants provide friction stir welding techniques wherein sufficient pressure of plastic flow is achieved so as to activate the boundary surfaces to weld the members, and which is used for forming a friction stir lap weld between different metals. Applicants have found that by pressing the welding tool into only one of the members, with the welding tool having a specific tip end configuration, the welding boundary surface can be activated and welded by plastic flow, achieving objections of the present invention.

Boon, et al. discloses a mobile friction welding machine, for forming a joint region between overlapping members of lead, using a multiprong whisk type tool. Note, especially, column 3, lines 6-28, of this patent.

It is respectfully submitted that this patent does not disclose, nor would have suggested, such friction stir welding method for a lap joint as in the present claims, including, inter alia, wherein at least two of the plurality of members are of different metals from each other, and wherein the welding tool is pressed into only one of the members.

In connection with the interpretation by the Examiner of Boon, et al., Applicants respectfully traverse the conclusion by the Examiner that Boon, et al. discloses a tool wherein the small diameter portion is semispherical. As can be seen in, e.g., Figs. 1, 3 and 4 of Boon, et al., this patent discloses multiple prongs; and it is respectfully submitted that this patent does not disclose, nor would have suggested, the semispherical small diameter portion as in the present claims, and/or other features of the present invention as discussed previously.

No. 10-230376 (referred to by the Examiner as "Showa") discloses a metallic plate shape joined body, obtained by joining mutual end parts of two plate shape metallic joining members, one of the members having a bent part, the bent part of one of the joining members and the end part of the other joining member being superposed so that one side surfaces of both joining members are arranged on the same flat surface. This patent document discloses that under this state, a rotating pin shape probe 32 is inserted in the superposed direction from the outside of the bent part, with frictional agitation joining being applied.

It is respectfully submitted that this patent document would have neither taught nor would have suggested the joining of different metals; and it is respectfully submitted that this patent document would have taught away from such method as in the present claims, wherein the welding tool is pressed into only the one of the members. Moreover, Applicants respectfully traverse the conclusion by the

Examiner that No. 10-230376 shows a semispherical small diameter portion; it is respectfully submitted that this patent document shows a conventional pin shape probe, not a semispherical small diameter portion.

No. 2001-314982 (referred to by the Examiner as "Kawasaki") discloses a method of spot joining, wherein two works such as aluminum alloy plates are placed in piles on a receiving member, a joining tool is lowered while rotating, whereby the joint part of the work is heated and softened by frictional heat of the rotating joining pin, plastic flow is caused and agitated, and the work is united in a body at the joint part to achieve the spot joining.

Noting, e.g., Fig. 4 of No. 2001-314982, it is respectfully submitted that this patent document would have taught away from such method as in the present claims, wherein the welding tool is pressed into only the one of the members, and also would have taught away from such aspect of the present method wherein at least two of the plurality of members are of different metals from each other. Moreover, noting, e.g., Fig. 2 of No. 2001-314982, it is respectfully submitted that this document would have taught away from the small diameter portion being semispherical or other features of the welding tool as in the present claims, and advantages thereof.

Thomas, et al. discloses a friction stir welding technique, including use of a specific friction stir welding tool having a support body to which is mounted an elongate probe which in use extends into material to be welded on either side of a joint region, wherein the probe has, in cross-section, at least one flattened section such that during the rotational movement the probe presents, in a plane extending along the axis of rotation, a varying diameter across the joint region. See page 1,

lines 25-34. Note also the paragraph bridging pages 4 and 5; and see also a method of joining workpieces described in the paragraph bridging pages 5 and 6.

It is respectfully submitted that Thomas, et al. would have neither taught nor would have suggested such method as in the present claims, for a lap joint, in which a plurality of members are lapped; it is respectfully submitted that Thomas, et al. discloses friction stir welding of abutting members. Furthermore, it is respectfully submitted that Thomas, et al. discloses insertion of the elongate probe into both of the abutting members adjoining the joint region, and thus would have taught away from the welding tool being pressed into only the one of the members. Moreover, it is respectfully submitted that this reference would have neither disclosed nor would have suggested wherein at least two of the plurality of members are of different metals from each other, or the configuration of the welding tool, as in the present claims, and advantages thereof. As to the configuration, note that Thomas, et al. describes a flat portion such that during rotation, the probe in cross-section has a varying diameter across the joint region (that is, a side(s) of the probe, in cross-section, has a flat portion, as seen in Fig. 1A).

Aota, et al. discloses a friction stir welding method suitable for use in joining of members, and wherein at least one of the members to be joined has a thickened part, in cross-section, at the joining region thereof with another member, the thickened part protruding toward the rotary body used to perform the friction stir welding. This patent document discloses that the rotary body (welding tool) has, inter alia, a small diameter portion which is inserted in the joining region of the members to be joined, during the joining. See column 2, lines 47-56; and from column 2, line 63 through column 3, line 4.

It is respectfully submitted that Aota, et al. would have neither taught nor would have suggested such friction stir welding method as in the present claims, wherein the welding tool is pressed into only one of the members. It is respectfully submitted that Aota, et al. is silent with respect to at least two of the plurality of members being of different metals from each other.

Okamoto, et al. discloses a method of joining metallic materials by means of a rotating probe, wherein a pit or concave is formed in a joining portion of one of the materials to be joined, and then the joining portion of the other material is plasticized to generate plastic flow that enters into the pit. According to the technique described in Okamoto, et al., the two materials are not metallurgically bonded, but the materials are joined by a so-called mechanical joining method wherein the pit of one material is filled with the other material. See column 1, lines 38-51. Note also, for example, column 2, lines 39, 40 and 59-61; and column 3, lines 4-8 and 29-40.

As can be seen, for example, in Fig. 4 of Okamoto, et al., in this patent the probe 1 extends through the upper material 2 so as to enter the member of material 3. It is respectfully submitted that this patent would have neither disclosed nor would have suggested, and in fact would have taught away from, the presently claimed invention, including wherein the welding tool is pressed into only the one of the members. It is respectfully submitted that Okamoto, et al. is directed a different technique for joining metallic materials, utilizing only a mechanical joining, and would have neither disclosed nor would have suggested the present invention, including wherein the welding boundary surface is activated and welded by plastic flow.

In Item 10 on page 6 of the Office Action mailed June 15, 2006, the Examiner has referenced "Aota et al. (US 2003/0102354 A1)". More properly, it is respectfully submitted that the first-named inventor on this patent publication is Okamura, et al.,



and in the following this document is referred to as Okamura, et al. This patent document discloses a friction stir welding method for welding by use of a rotary tool having a pin portion and a shoulder portion, wherein the members to be welded are abutted against each other, a pin portion of a rotary tool is inserted to one of the members, while the pin portion is not inserted to the other of the members but only a shoulder portion of the rotary tool is brought into contact with the other of the members. Note paragraph [0007] on page 1 of this document. Note also paragraphs [0008] and [0029] respectively on pages 1 and 2 of this document. See also paragraph [0042] on page 4 of this document.

It is respectfully submitted that Okamura, et al. is directed to a friction stir welding technique for abutting members. It is respectfully submitted that this patent document does not disclose, nor would have suggested, a friction stir welding method for a lap joint, in which a plurality of members are lapped. Moreover, it is respectfully submitted that this patent document discloses a technique wherein the shoulder of the welding tool is provided in contact with the other member into which the pin portion of the rotary tool is not inserted. It is respectfully submitted that the disclosure of Okamura, et al., as a whole, would have taught away from that aspect of the present invention, providing a lap joint, and wherein the welding tool is pressed into only one of the members.

Furthermore, it is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested the technical feature behind the present invention, wherein the welding tool is pressed into only one of the lapped members of different metals so as to generate plastic flow therein, to activate the boundary surfaces to weld the members; and, moreover, it is respectfully submitted that these references do not disclose, nor would have

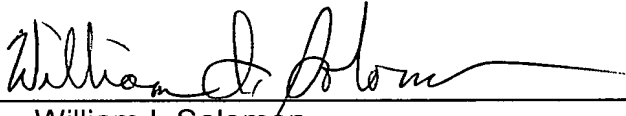
suggested, the features of the present invention as discussed in the foregoing, including features as in the various dependent claims as discussed previously.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently in the application are respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including any extension of time fees, to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (case No. 500.45682X00), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

**ANTONELLI, TERRY, STOUT & KRAUS, LLP**

By   
William I. Solomon  
Registration No. 28,565

WIS/kmh/ksh  
1300 N. Seventeenth Street  
Suite 1800  
Arlington, VA 22209  
Tel.: 703-312-6600  
Fax.: 703-312-6666